CVD Synthesis of Large Area Twisted Multilayer Graphene

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Multilayer graphene (MLG) has introduced a novel twist in future electronics after the astounding discovery of MIT researchers [1]. Bilayer graphene (BLG) shows staggering properties when twisted at the magic angle of 1.1^0. In order to leverage the complete potential and inherent properties at a great extent in this advanced regime, synthesis of large area twisted MLG (t-MLG) is crucial.
Thus, we have developed a promising and time effective CVD approach for the large area synthesis of t-MLG by using methane as a carbon source and Cu foil as the substrate. In our samples, we have observed a variable range of twist angle of MLG domains with a minimum twist of 5.1^0. We found that maximum flake size of our bilayer domain is 168 micron in a growth time of 100 minutes, which is far better than complex and time-consuming (6h and more) approaches previously reported [2]. We confirmed the partial presence of M-band [3] in the RAMAN signature that also confirms the stacking (twist angle) of layers in our samples observed by SEM and optical microscopy. We are exploring twist dependent properties such as mobility, resistivity, modulus of elasticity, to understand the full potential of t-MLG for electromechanical devices. Mechanism of twisted graphene via CVD process is not clear so far. We proposed a time effective approach for the synthesis of large area t-MLG via controlling annealing parameters and hydrogen to methane ratio. Our results will give a spark towards the controllable synthesis of twisted BLG & MLG.

References

[1] Yuan C., Valla F., Shiang F. et al. Nature, 556, (2018), 43-50.
[2] Yufeng H., Lei W., Yuanyue L. et al. Nature Nanotechnology, 11, (2016), 426-431.
[3] Chunxiao C., Ting Y., Riichiro S. et al. ACS Nano, 5, 3, (2011)1600-1605.

Figures

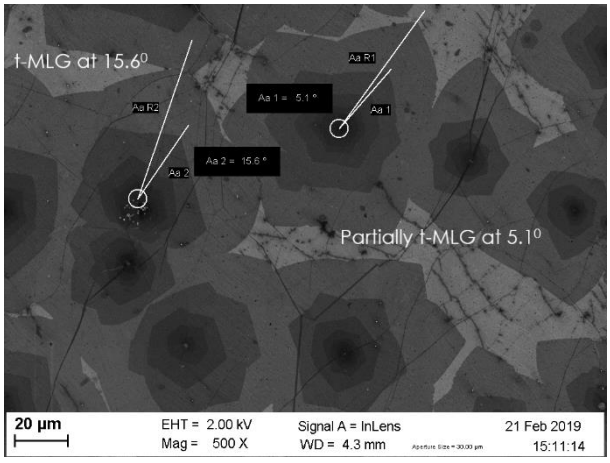

Figure 1: SEM Image of CVD synthesized twisted MLG

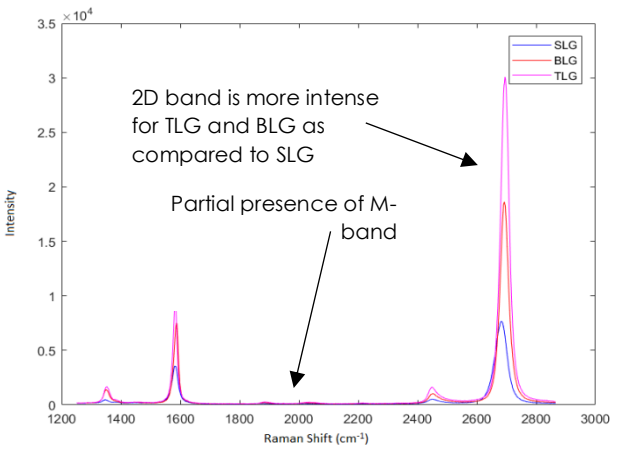

Figure 2: RAMAN spectra of twisted MLG's